The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

Paper No. 18

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

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Ex parte ROBERT E. LIKINS, RICHARD C. BLISH, II, SHARAD M. SHAH, SIDHARTH, and DEVENDRA NATEKAR

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Appeal No. 2004-0760
Application No. 10/010,392

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ON BRIEF

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Before ABRAMS, MCQUADE, and NASE, Administrative Patent Judges.

MCQUADE, Administrative Patent Judge.

DECISION ON APPEAL

Robert E. Likins et al. originally took this appeal from the final rejection of claims 5 through 16 and 30. The appellants have since canceled claims 11, 15 and 16, and amended claim 5, leaving for review the standing rejection of claims 5 through 10, 12 through 14 and 30. Claims 3 and 22 through 29, the only other claims pending in the application, stand withdrawn from consideration.

THE INVENTION

The invention relates "generally to semiconductor structure, and more particularly, to structure for suppressing semiconductor chip curvature and reducing chip temperature while improving device speed and reliability" (specification, page 1). Representative claim 5 reads as follows:

> 5. A semiconductor structure comprising:
>
> a substrate;
>
> a semiconductor device secured to the substrate; and
>
> a stabilizing member secured to the semiconductor device;
>
> the bending stiffness of the substrate being generally similar to the bending stiffness of the stabilizing member, wherein;
>
> bending stiffness = Et^3, with E = Young's modulus, and t = thickness;
>
> wherein Young's modulus of the stabilizing member is greater than Young's modulus of the substrate.

THE REJECTION

Claims 5 through 10, 12 through 14 and 30 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,811,317 to Maheshwari et al. (Maheshwari).

Attention is directed to the main and reply briefs (Paper Nos. 12 and 14) and the answer (Paper No. 13) for the respective positions of the appellants and the examiner regarding the merits of this rejection.

DISCUSSION

Maheshwari discloses a method of attaching silicon dies (i.e., flip chips) onto flexible substrates in a manner which minimizes warping and cracking of the dies. In a typical flip chip attaching process, the die is fluxed and placed on the substrate with bond pads on the die aligned with bond pads on the substrate, solder is reflowed between the bond pads, the die is underfilled with a thermoset material, and the underfill material is fully cured (see column 1, lines 16 through 21). The warpage problem stems from the so-called "bi-metallic strip" effect caused by relatively large differences in the respective coefficients of thermal expansion (CTE) of the die and the thermoset underfill material. The following passage fairly summarizes Maheshwari's solution to this problem:

> The "bi-metallic strip" effect . . . can be compensated for by applying an opposing layer of thermoset component adhered to a metal sheet or other material with applicable CTE on the top of the die, as illustrated in **FIG. 2.** This offsetting layer of material causes the die to warp on the other side and as a result the two self-opposing warpage effects will

neutralize themselves. This thermoset epoxy can be an underfill material itself, or overmoulding compound or silver filled epoxy with comparable C.T.E. as the underfill. The balance plate should be made out of material (can be made out of Copper, Aluminum etc.) with a comparable CTE and modulus of elasticity to the flexible substrate material.

The flow in a flip chip attach process according to a preferred embodiment of the invention begins with fluxing of the die. Next, the die is placed on the substrate (presently available in ceramic, epoxy board, laminate, flex, polyimide, "UPILEX" or "KAPTON" and which sometimes includes a stiffener layer of copper, aluminum, or an alloy and preferably having a CTE close to that of the non-conductive substrate, for those substrate materials requiring reinforcement, with bond pads on the die being aligned with bond pads on the substrate. Solder is reflowed between bond pads on the die an substrate, resulting in the structure illustrated in **FIG. 3**, step **2**. Next, the die is underfilled with a thermoset material (or other non-conductive material similar to thermoset having a good flow rate, lack of voiding and good adhesion to solder and solder masks) until the material has wicked under the die - as illustrated in **FIG. 3**, step **3**. The underfill material is then heated to a temperature at which it gels but does not harden (the gelling temperature and time are material dependent) thus no complete curing . . . .

An attach epoxy (overfill material), such as silver filled thermosetting epoxy, or thermally conductive epoxies, etc. (overfill material), is dispensed on the die surface as illustrated in **FIG. 3**, step 4, on or top of the balance plate itself (or an over molding material that balances out the stresses in the lamination of the structure). The metal sheet (or over molding material) is positioned on the die or on the die and stiffener material, as illustrated in **FIG. 3**, step **5**. The entire assembly is then cured in one single step [column 2, line 36, through column 3, line 20].

Anticipation is established only when a single prior art reference discloses, expressly or under principles of inherency, each and every element of a claimed invention. RCA Corp. v. Applied Digital Data Sys., Inc., 730 F.2d 1440, 1444, 221 USPQ 385, 388 (Fed. Cir.), cert. dismissed, 468 U.S. 1228 (1984).

As framed and argued by the appellants, the dispositive issue in the appeal is whether Maheshwari meets the limitations in independent claim 5 requiring (1) the bending stiffness of the substrate to be generally similar to the bending stiffness of the stabilizing member, where bending stiffness is Et^3 with E being Young's modulus and t being thickness, and (2) Young's modulus of the stabilizing member to be greater than Young's modulus of the substrate.

Although Maheshwari lacks an express teaching thereof, the examiner finds (see pages 4 and 5 in the answer) that Maheshwari's semiconductor structure includes a substrate (the flexible substrate) and a stabilizing member (the balance plate) having the relationship specified in claim 5. According to the examiner (see pages 8 through 10 in the answer), (1) the bending stiffnesses of the flexible substrate and balance plate are generally similar as calculated by Et^3 because these elements have the same thickness as shown in Figure 6 and a similar

Young's modulus (i.e., modulus of elasticity), and (2) the Young's modulus of the balance plate is greater than the Young's modulus of the flexible substrate because the balance plate may be made of copper or aluminum and the flexible substrate may be made of epoxy board or a polyimide.

Neither of these prongs in the examiner's analysis stands up under careful review of the Maheshwari disclosure.

To begin with, it is well established that patent drawings do not define the precise proportions of the elements shown therein and may not be relied on to show particular sizes if the specification is completely silent on the issue. Hockerson-Halberstadt, Inc. v. Avia Group Int'l, 222 F.3d 951, 956, 55 USPQ2d 1487, 1491 (Fed. Cir. 2000). Maheshwari's specification contains no indication that the flexible substrate and the balance plate have the same thickness or that Figure 6 accurately portrays these elements in terms of their relative thickness. Indeed, Figures 2, 3e and 4 depict these same elements as having significantly different thicknesses, thereby undermining the examiner's reliance on Figure 6 in this regard. Hence, Figure 6, considered in light of the Maheshwari reference as a whole, does not fairly teach that the flexible substrate and the balance plate have the same thickness, and consequently lends

no support to the examiner's thesis that these elements have generally similar bending stiffnesses.

Furthermore, while listing various examples of the materials from which the flexible substrate and the balance plate may be made, including epoxy board or a polyimide for the flexible substrate and copper or aluminum for the balance plate, Maheshwari fails to teach how these various materials might be matched to one another or, more to the point, that the Young's modulus of the balance plate should be greater than the Young's modulus of the flexible substrate. Anticipation is not established if, as in the present case, it is necessary to pick, choose and combine various portions of the disclosure not directly related to each other by the teachings of the reference. In re Arkley, 455 F.2d 586, 587-88, 172 USPQ 524, 526 (CCPA 1972).

Thus, the fair teachings of Maheshwari do not justify the examiner's determination that the subject matter recited in claim 5 is anticipated by the prior art. Accordingly, we shall not sustain the standing 35 U.S.C. § 102(b) rejection of claim 5, and dependent claims 6 through 10, 12 through 14 and 30, as being anticipated by Maheshwari.

SUMMARY

The decision of the examiner to reject claims 5 through 10, 12 through 14 and 30 is reversed.

REVERSED

NEAL E. ABRAMS Administrative Patent Judge	)	
JOHN P. MCQUADE Administrative Patent Judge	)	BOARD OF PATENT APPEALS AND INTERFERENCES
JEFFREY V. NASE Administrative Patent Judge	)	

JPM/hh

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